

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

THE SYSTEMATICS OF SOME NEW WORLD
MURICID SPECIES (MOLLUSCA, GASTROPODA),
WITH DESCRIPTIONS OF TWO NEW GENERA
AND TWO NEW SPECIES

BY GEORGE E. RADWIN AND ANTHONY D'ATTILIO
*Dept. of Marine Invertebrates, San Diego Natural History
Museum, San Diego, California 92112*

Intensive examination of material in the preparation of a guide to the species and genera of the Muricidae of the world, has led to a number of interesting revelations. Among these has been a better understanding of the relationship of several small, non-spinose forms most frequently assigned to the genus *Morula* Schumacher, 1817. This genus has been one of the more notorious catchall groups. Many otherwise unaffiliated species with non-varicate shells and denticulate apertures have been placed here. This has been done seemingly without regard to the restrictions implied by the choice of type-species.

The following abbreviations indicate the sources of the specimens we examined and cite in this study. SDSNH—San Diego Society of Natural History (Natural History Museum, San Diego, California); LACM—Los Angeles County Museum of Natural History; USNM—United States National Museum (National Museum of Natural History, Washington, D.C.).

FAMILY THAIDIDAE

Subfamily Drupinae

Morula Schumacher, 1817

Morula Schumacher, 1817, p. 68: type-species: *Morula papillosa* Schumacher, 1817 (= *Drupa uva* Röding, 1798), by monotypy.

Diagnosis: Shell moderately small (20-25 mm), thick, broadly subfusiform; spire high and acute; aperture weakly sinuous and generally

constricted by several prominent labial denticles; columella with a prominent medial, oblique fold; radula roughly similar to that of *Drupa* but with the base of the rachidian tooth modified and with denticles on the rachidian in a level, transverse line rather than an oblique orientation as in *Drupa*; operculum similar to that of *Drupa*. Protoconch two-whorled.

Morula uva (Röding, 1798)

Figure 1K

Drupa uva Röding, 1798, p. 56, no. 703.

Ricinula aspera Lamarck, 1816, pl. 395, figs. 4a, 4b.

Ricinula nodus Lamarck, 1816, pl. 395, figs. 6a, 6b.

Morula papillosa Schumacher, 1817, p. 277.

Ricinula morus Lamarck, 1822, vol. 7, p. 232.

Purpura sphaeridea Duclos, 1832, vol. 26, p. 7, pls. 2, fig. 10.

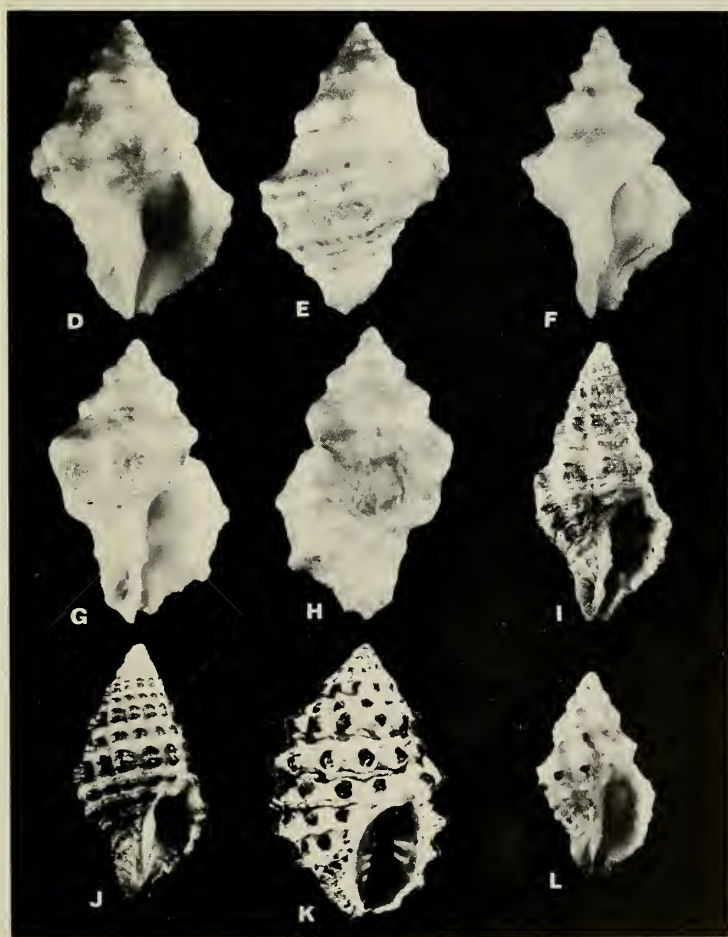
Ricinula alba Mörch, 1852, p. 87.

Distribution: Generally throughout the Indo-West Pacific; no type-locality has ever been designated.

The shell is moderately small (maximum length—27 mm) and stoutly sub-fusiform. The spire is high and acute, consisting of five weakly shouldered postnuclear whorls and a protoconch of approximately two whorls. The sutures are well impressed, although this feature is not as well marked on the upper spire whorls. The body whorl is large and broadly fusoid. The aperture is narrow and irregular; with a narrow,

→

FIG. 1 (A-L). *Evokesia ferruginosa* (Reeve, 1856). SDSNH 44183, Pond Island, Baja California, Mexico. (4×). B. *Trachypollia sclera* Woodring, 1928. (paratype), USNM 135520, Loc. 2580, Bowden, Jamaica (Miocene). (10×). C. *Trachypollia nodulosa* (C. B. Adams, 1845). A. D'Attilio Coll., Ilha Grande, Brazil. (5×). D. *Bizetiella shaskyi* sp. nov. (holotype), SDSNH 56119, one mile south of Puerto Ballea, Maria Madre Island, Tres Marias Islands, Nayarit, Mexico. (9.5×). E. *B. shaskyi* sp. nov., data same as above, dorsal view. (9.5×). F. *Bizetiella carmen* (Lowe, 1935). (paratype), SDSNH 44717, off Carmen Island, Baja California, Mexico. (10×). G. *Bizetiella micaela* sp. nov. (holotype), SDSNH 56118, Bahia Coastocomate, Jalisco, Mexico (10×). H. *B. micaela* sp. nov., data same as above, dorsal view. (10×). I. *Trachypollia lugubris* (C. B. Adams, 1852). SDSNH 32985, Cedros Island, Baja California, Mexico. (6.5×). J. *Trachypollia didyma* (Schwengel, 1943). A. D'Attilio Coll., off Palm Beach, Florida. (7×). K. *Morula uva* (Röding, 1798). SDSNH 56269, West side of Oeno Island, Tuamotu Archipelago. (3.5×). L. *Evokesia rufonotata* (Carpenter, 1864). LACM 68-41, South side of Bahia Coastocomate, Jalisco, Mexico. (6.5×).



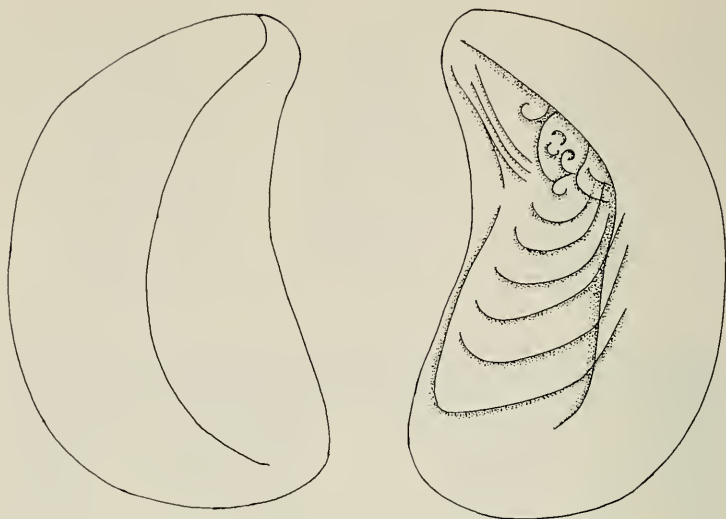


FIG. 2. *Morula uva*: operculum—left, interior; right, exterior.

deep anal sulcus. The outer apertural lip is non-erect and strongly denticulate on its inner surface. Just above the middle of the lip on this surface five tubercles are apparent. The uppermost one is largest, the next one somewhat smaller, followed by three smaller equal-sized ones. The inner lip is adherent above, barely detached and non-erect below. The anterior half of the inner lip bears two to four weak nodules. Medially on the inner lip and recessed more deeply into the aperture, a single weak to moderately strong, transverse to weakly oblique fold is apparent. The siphonal canal is short, generally straight and moderately broadly open.

The shell is essentially non-varicate. Axial sculpture consists of nine low costae, prominently nodulose or prickly over the major spiral elements. Spiral sculpture consists of major and minor cords. One or two minor cords on the shoulder are followed at the shoulder margin by a major cord. Below this two minor cords separate the shoulder margin cord from the next major cord. Each of the remaining four major cords is separated from its neighbor by a single minor cord. The canal bears two minor cords. Shell color is yellowish white with some to all of the nodules colored brownish black. The aperture is lavender when the lip is mature.

The operculum is small, opaque, black and kidney shaped. This shape is apparently related to the narrow, emarginate aperture.

The radula is small and unusually short compared to that of other muricine, ocenebrine, and thaidid species examined. In addition to the

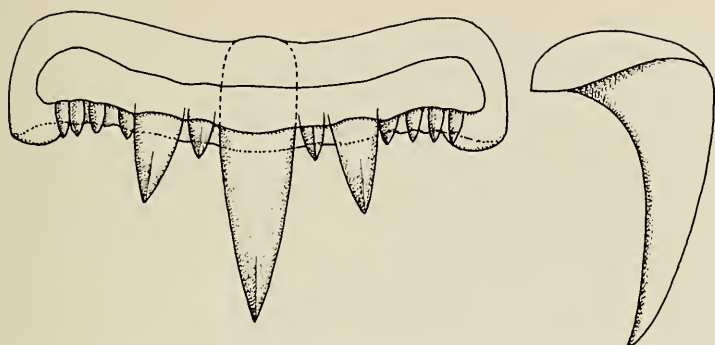


FIG. 3. *M. uva*: two-thirds of a transverse row of radular teeth.

small size of the teeth themselves, the brevity of the radula is attributable to a smaller number of tooth-rows than is typical for the family. Whereas most muricid radulae have 250–400 transverse rows of teeth, the present one had no more than 150 rows, including nascent (incompletely formed) teeth at the newest end of the ribbon.

The lateral teeth, one flanking the rachidian (central) tooth on each side, are unexceptional, save for their small size. The rachidian is generally muricoid but differs from rachidians in other groups in details of morphology. The base of the tooth is quite broad and, although possessing considerable thickness, does not show the cowl-like structure bearing the central cusp, as shown in ocenebrine and muricopsine species (Radwin & D'Attilio, 1972). The ends of the tooth-base are blunt and knoblike, lacking the single or double points found elsewhere in the family. The central cusp is very long and pointed but does not project appreciably beyond the lateral cusps. The lateral cusps are somewhat set in from the ends of the base. Between each lateral and the central cusp a single, very small, independent, intermediate cusp is evident. Immediately outside of each lateral cusp is a series of four small, equal-sized, independent denticles, each one not much smaller than the intermediate cusps. These denticles are in a straight, transverse orientation, not in an arching, oblique line as in most ocenebrine species. Of the several Indo-Pacific moruloid species whose radulae we have examined and those that have been figured in the literature (Arakawa, 1962, 1964, 1965; Wu, 1965, 1968), the only species clearly resembling this one in the details of its radular dentition is *Morula porphyrostoma* (Reeve, 1846). Other species may also belong here but those species having closely similar shells but widely divergent radulae indicate the complex and probably polyphyletic composition of *Morula* as presently understood. As Indo-Pacific species with similar shells are found to be dissimilar

in other ways, we have begun to study all "moruloid" species, regardless of region, for their true affinities.

With respect to the above, Emerson and Hertlein (1964) have preceded us in proposing the muricid subgenus *Morula* (*Morunella*) (type-species: *Buccinum lugubris* C. B. Adams, 1852). *Morunella* is predated by *Trachypollia* Woodring (1928), a fossil genus which was placed in the Nassariidae. The first two authors included, in addition to the type-species, a western Atlantic species, *T. didyma* (Schwengel, 1943). We are adding another Recent species, *T. nodulosa* (C. B. Adams, 1850).

FAMILY MURICIDAE

Subfamily Ocenebrinae

Trachypollia Woodring, 1928

Trachypollia Woodring, 1928, p. 268; type-species, *T. sclera* Woodring, 1928, by original designation.

Morula (*Morunella*) Emerson & Hertlein, 1964, p. 361, type-species *Buccinum lugubris* C. B. Adams, 1852, p. 293.

Diagnosis: Shell small (12–20 mm), moderately thick, fusiform to sub-fusiform and non-variccate; spire high and acute; aperture ovate or sub-ovate and generally not strongly constricted; outer apertural lip generally thin, exceptionally, moderately thickened; inner lip denticulate but lacking a fold; sculpture finely to coarsely nodulose; radular dentition ocenebrine, with lower corners of rectangular base of rachidian tooth bearing points, denticles in oblique orientation; operculum ocenebrine, protoconch consisting of three and one-half convex, papillose whorls.

In addition to the type-species and the Recent species treated below, one other extinct fossil species has been reported. *Drupa* (*Morula*) *gilbertharrisi* Weisbord, 1962 appears, from the figure, to most closely resemble *T. lugubris*, although certain details of sculpture, proportion, and size serve to separate these two species.

Trachypollia lugubris (C. B. Adams, 1852)

Figure 11

Buccinum lugubre C. B. Adams, 1852, vol. 5, p. 293.

Latirus lugubris (Adams) Pilsbry & Lowe, 1932, vol. 83, p. 114.

Cantharus lugubris (Adams) T. Burch, 1940, vol. 54, p. 47, pls. 2, figs. 5–7.

Drupa lugubris (Adams) T. Burch, 1942, no. 17, p. 7.

Morula lugubris (Adams) Keen, 1958, p. 376, fig. 412.

Morula (*Morunella*) *lugubris* (Adams) Emerson & Hertlein, 1964, vol. 13, no. 17, p. 361.

Distribution: Redondo Beach and San Diego, California to Panama. The type-locality of *T. lugubris* is "Panama (City) and Taboga Island

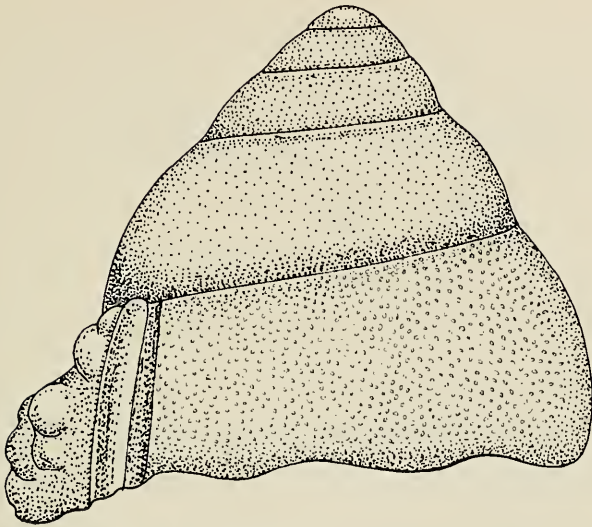


FIG. 4. *Trachypollia lugubris*: protoconch.

(Panama).” Fossil records from the Pleistocene have been reported (Emerson & Hertlein, 1964).

The shell is small (10–18 mm) and fusiform. The spire is quite high, consisting of five or six subangulate postnuclear whorls and a protoconch of three and one-half papillose, convex whorls (see Burch, 1940). The sutures are well defined. The body whorl is moderately large and fusoid. The aperture is moderately large and broadly ovate, with a narrow, deep anal sulcus. The outer lip is thin and minutely crenulate, reflecting the spiral sculpture of the shell surface. The inner surface of the outer lip bears six weak denticles recessed a short distance into the aperture. Each denticle corresponds to the trough between two major spiral cords. The inner lip is completely adherent, bearing a small knob delimiting the parietal extent of the anal sulcus, and a series of three moderately strong denticles at its anterior end. The anterior two of these denticles are closer together than they are to the third. The siphonal canal is moderately short, open, and bent to the left.

The shell is essentially non-variccate. Axial sculpture consists of eight to ten costae with shallow interspaces. These costae are most prominent over the major spiral cords. Spiral sculpture consists of primary, secondary, and tertiary scabrous cords. The shoulder bears three or four undulate, tertiary cords. One primary cord is evident subsuturally, a pair are present at the shoulder margin and three single primaries are evenly distributed over the lower half of the body. Between the pair of primary cords at the shoulder margin and the primary below, and between each

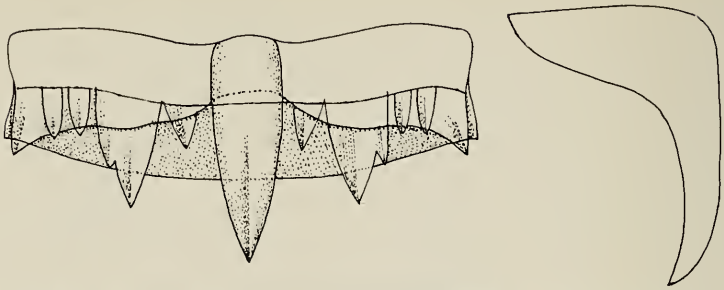


FIG. 5. *T. lugubris*: two-thirds of a transverse row of radular teeth.

two succeeding primary cords, three secondary cords are apparent, the outer two appended to their respective neighboring primary cords. Two secondary cords are found at the top of the siphonal canal, the bottom half of which is smooth. Where the primary cords intersect the axial costae, small, sharp nodules are developed.

Shell color is light tan to pale fleshy brown, including the aperture. The nodules are colored deep red-brown. Considerable variation in the size and overall proportions of the shell may be found, particularly associated with geographical (i.e. population) differences.

The radula is more or less ocenebrine. The lateral teeth are sickle shaped and of moderate size. The rachidian tooth is moderately broad, with the lower angles of the rectangular base produced into cusplike points. A long, slender central cusp projects a short distance forward on a narrow cowl. Flanking the central cusp on each side is a moderately short, independent, intermediate cusp. The lateral cusps, to the right and left of their respective intermediates, are moderately long and broad. In some views a single denticle is seen appended to the outer surface of each lateral cusp. Between each lateral cusp and the end of the tooth, a series of two or three moderately large denticles are apparent.

The operculum is thin, corneous, and almost semicircular. No growth lines are apparent on its outer surface; the inner surface shows traces of growth lines at one end and also bears a series of erratically concentric, ephemeral ridges. It appears to be ocenebrine.

Trachypollia didyma (Schwengel, 1943)

Figure 1J

Drupa didyma Schwengel, 1943, vol. 56, pp. 76-77, pl. 7, fig. 7.

Morula (Morunella) didyma (Schwengel) Emerson & Hertlein, 1964, vol. 13, no. 17, p. 361.

Distribution: Known only from the southeastern coast of Florida; Palm Beach (type-locality) in 200 feet to off Miami in 120 ft.

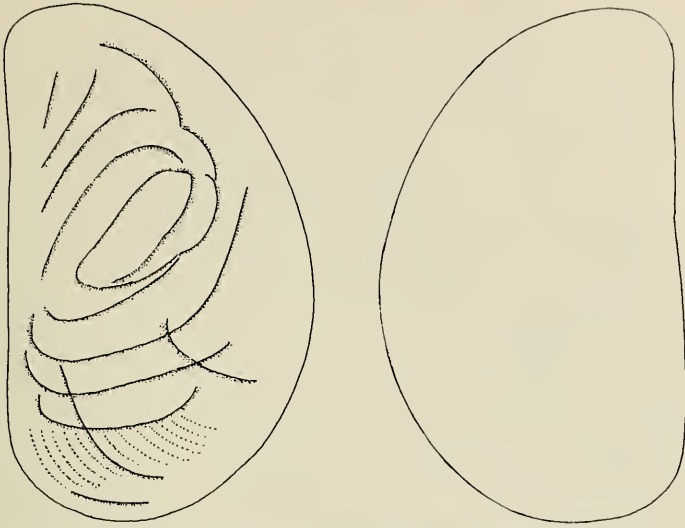


FIG. 6. *T. lugubris*: operculum—left, exterior; right, interior.

The shell of *T. didyma* is small (5–12 mm) and fusiform. The spire is high, consisting of three and one-half papillose, convex nuclear whorls and six strongly nodulose, postnuclear whorls. The sutures are impressed. The body whorl is moderately large and fusoid. The aperture is ovate to lenticular, with a well marked, U-shaped anal sulcus, the parietal margin of which is formed by a moderately strong transverse ridge. The outer apertural lip is unthickened and finely crenulate. On the inner surface of the outer lip, recessed a short distance into the aperture, a series of five moderately weak denticles are evident, diminishing in size with anterior progress. The inner lip is adherent at its posterior extremity; detached and weakly erect for its remaining length. At its anterior end the inner lip bears two oblique, elongate denticles. The siphonal canal is moderately short, open, weakly bent to the left and dorsally recurved.

The non-varicose shell has axial sculpture that consists of 13 low costae, nodulose over the major spiral cords. Spiral sculpture consists of major and minor cords. The major cords are distributed thusly: one subsuturally, a pair at the shoulder margin, three distributed evenly over the anterior half of the body, and one or two on the canal. Two minor cords are found between the subsutural major cord and the paired major cords at the shoulder margin. Additional single minor cords alternate with each major cord on the remainder of the body and canal. Small, sharp, hemispherical nodules are developed where the major cords intersect the costae.

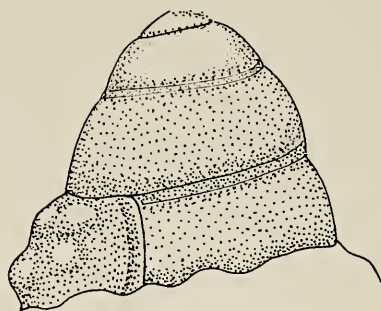


FIG. 7. *Trachypollia didyma*: protoconch.

Shell color is yellow-ochre with red-brown on the major spiral cords, strongest on the nodules. The aperture is fleshy white with deeper fleshy pink on the columellar denticles.

The radula, as in the previous species, is essentially ocenebrine. The major differences between the radulae of the two species is the chunkier, more compact base of the rachidian tooth and the relatively larger size of the lateral tooth in *T. didyma*. The most likely explanation of the former difference is that the entire tooth of *T. didyma* is very strongly

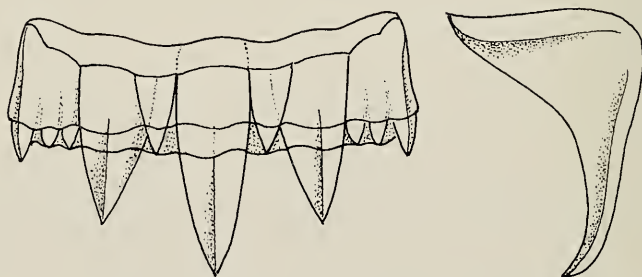


FIG. 8. *T. didyma*: two-thirds of a transverse row of radular teeth.

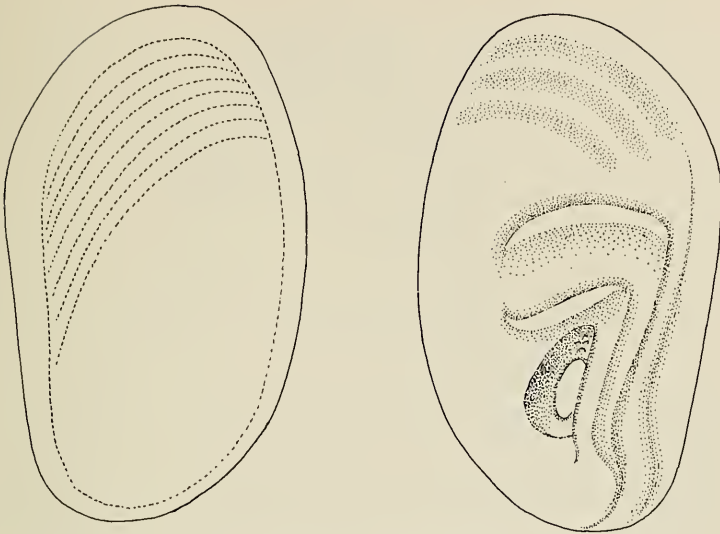


FIG. 9. *T. didyma*: operculum—left, exterior; right, interior.

curved, imparting a more compact appearance to the cusp arrangement. The lower corners of the base are produced into cusplike points. The central cusp is moderately long and quite broad and projects a short distance from the other cusps on a moderately narrow cowl. On each side of the central cusp there is a single, moderate-sized, independent, intermediate cusp, a large lateral cusp, and two small denticles.

The operculum is thin, corneous and sub-ovate. The outer surface has about eight faint growth lines at one end, the remainder is featureless. The inner surface shows indication of some of the growth lines in the form of three moderately broad, roughly concentric low ridges. Toward the center of the operculum several additional ridges lose their regular concentric configuration and turn at right angles to the normal course. In most ways the operculum is ocenebrine.

The restricted range of this species whose closest apparent relative is the widely distributed eastern Pacific *T. lugubris*, may indicate that *T. didyma* is a relict species whose former range may have been much more extensive. Unfortunately, no fossil records of this species are known to us.

Trachypollia nodulosa (C. B. Adams, 1845)

Figure 1C

Purpura nodulosa C. B. Adams, 1845, vol. 2, pp. 2-3.

Ricinula nodulosa (Adams) Tryon, 1880, vol. 2, p. 190, pl. 59, fig. 275.

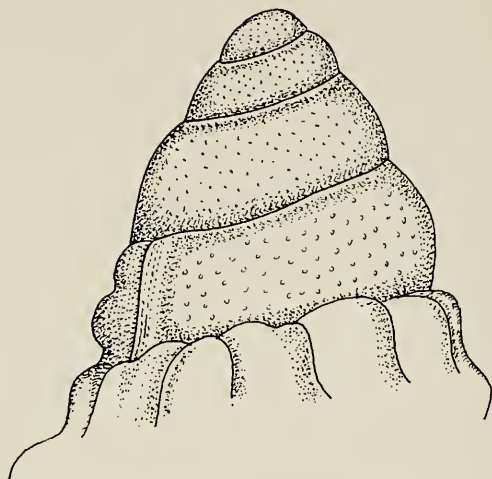


FIG. 10. *Trachypollia nodulosa*: protoconch.

Sistrum nodulosa (Adams) Johnson, 1934, vol. 40, no. 1, p. 118.

Drupa nodulosa (Adams) Warmke and Abbott, 1961, p. 106, pl. 19, fig. e.

Distribution: Throughout the entire Caribbean faunal province; south-eastern Florida to southern Brazil, and west to Central America. Fossil range extends from the Mid-Miocene of Costa Rica (see Olsson, 1922, p. 133) to the Recent.

The shell of *T. nodulosa* is large for the genus (14–20 mm) and roughly fusiform. The spire is high and acute, consisting of a protoconch of three and one-half papillose, convex whorls and five or six weakly convex, postnuclear whorls. The sutures are weakly marked. The body whorl is moderately large and roughly fusoid. The aperture is narrow and sub-ovate, with a narrow, moderately shallow anal sulcus parietally delimited by a broad, low node-like ridge. The outer apertural lip is non-erect and smooth marginally. The inner surface of the outer lip bears four prominent denticles recessed a short distance from the apertural margin. The denticles diminish in size with anterior progress. The inner lip is entirely adherent, bearing three oblique, elongate denticles at its anterior end. The siphonal canal is moderately short, open, and barely bent to the left.

The presence of varices is difficult to determine. One or more apparent varices occur erratically but their number and position are not consistent. The animal does apparently pause briefly after the formation of each costa, but these pauses are apparently too short to qualify as varices. Axial sculpture consists of seven to 10 low costae prominent

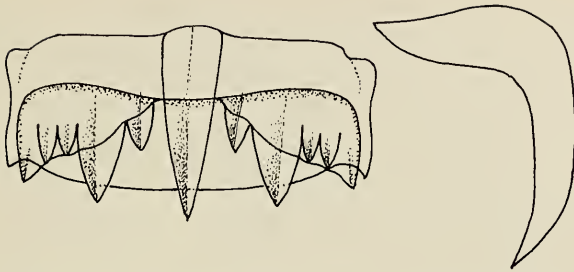


FIG. 11. *T. nodulosa*: two-thirds of a transverse row of radular teeth.

where they intersect the spiral elements. Spiral sculpture consists of five major cords on the body and one or two on the canal. One cord is subsutural, one cord is at the shoulder margin, and the remaining three are evenly distributed over the bottom half of the body. Where these cords intersect the costae, sharp nodules are developed. Between each two major cords six to 10 fine threads are evident.

Shell color is brown-black, in some specimens with white internodal spots on the shoulder margin cord and on an additional cord at the base of the body. The aperture is blue-gray with brown markings around the margin. The denticles are white.

The radula is essentially ocenebrine. Of the former two species the radula of *T. nodulosa* most closely resembles that of *T. lugubris*. The major differences are that the central cusp of the present species is slightly shorter than that of *T. lugubris* and that in no views of the radula of this species are any denticles appended to the outer surface of the lateral cusps. In addition, the lateral teeth are relatively smaller in *T. nodulosa*. The lower corners of the base of the rachidian are produced into cusplike points. The long slender central cusp protrudes slightly on a narrow cowl. On each side of the central cusp is a small, independent, intermediate cusp, a moderately large lateral cusp, and two small peripheral denticles.

The operculum was not available for study and comparison.

Several other species have been assigned to *Morula* or *Drupa*, or have been placed near these groups by implication. Examination of the shell, radula, protoconch and operculum of these forms has shown that they differ from both *Morula* and *Trachypollia*. A treatment of one such group follows.

Subfamily Muricopsinae Radwin & D'Attilio, 1972

Evokesia Radwin & D'Attilio, new genus

Type-species: *Sistrum rufonotatum* Carpenter, 1864.

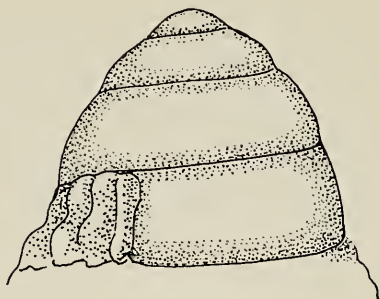


FIG. 12. *Evokesia rufonotata*: protoconch.

Diagnosis: Shell small to moderately small (15–30 mm), thin to moderately thick, fusiform to sub-fusiform and non-variccate; spire moderately high to very high and acute; aperture ovate and more or less constricted anteriorly, outer apertural lip thin to moderately thickened marginally, lirate to weakly denticulate within; inner lip entirely adherent and smooth; sculpture consisting of sharply raised, transversely elongate nodes; radular dentition muricopsine (Radwin & D'Attilio, 1972); rachidian tooth with lower corners of base weakly pointed if at all; no denticles present; five cusps present, moderate-sized lateral cusps, small intermediate cusps, and a long, sharp, central cusp projecting forward on a narrow cowl; lateral teeth simple; operculum closest to muricine type; protoconch of three swollen, papillose or granulose whorls.

In addition to the two species treated below, one Caribbean species apparently belongs in *Evokesia*. On the basis of a comparison of the shell and radular dentition, the systematic placement of *Nassarina* (*Nassarina*) *grayi* Dall, 1889 in *Evokesia* is indicated.

Etymology: The basis for this patronym is Dr. Emily H. Vokes, whose delineation of the New World Cenozoic Muricidae has assisted us immeasurably in understanding the evolution of this family.

Evokesia rufonotata (Carpenter, 1864) NEW COMBINATION

Figure 1L

Sistrum (?*ochrostoma*, var.) *rufonotatum* Carpenter, 1864, ser. 3, vol. 14, p. 48.

Morula rufonotata (Carpenter) Keen, 1968, vol. 10, no. 4, p. 435.

Attilosia rufonotata (Carpenter) Keen, 1971, p. 530, fig. 1022.

Distribution: Cabo Pulmo, Baja California and the Tres Marias Islands to Manzanillo, Mexico, the Revillagigedo Islands, and the Galapagos Islands.

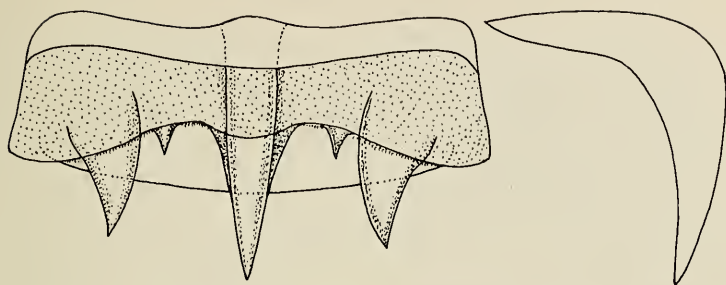


FIG. 13. *E. rufonotata*: two-thirds of a transverse row of radular teeth.

The shell of *E. rufonotata* is small (10–20 mm) and heavily fusiform. The spire is high, consisting of three and one-half convex, rapidly expanding, granulose nuclear whorls and four to six weakly angulate postnuclear whorls. The sutures are weakly impressed. The body whorl is moderately large and more or less swollen. The aperture is sub-ovate and moderate in size, with a broad, moderately deep anal sulcus. The outer apertural lip is weakly erect and minutely crenulate. The inner surface of the outer lip bears five or six moderately weak lirae, diminishing in strength with anterior progress. The inner lip is entirely adherent and smooth. The siphonal canal is short, open, weakly bent to the left and dorsally recurved.

The non-varicose shell has axial sculpture consisting of six to eight more or less strong costae, most prominent at their intersection with the major spiral cords. Spiral sculpture consists of major and minor cords which are only apparent over the axial costae; the interspaces are devoid of spiral sculpture. The shoulder is bare, followed by a major cord at the shoulder margin, one medially on the body, and one at the base of the body. Minor cords alternate with these majors on the body; the upper half of the canal bears two or three minor cords as well. Moderately sharp, more or less prominent nodules are developed where the major spiral cords intersect the costae.

Shell color is white to light tan, with more or less consistent darker brown markings on the receding slopes of the knobs. The apertural margin is white, with a marked gold-colored suffusion more deeply within. Shell proportions may vary with the population, as some specimens are short and globose and others are more slender and almost fusinoid in shape.

The radula is muricopsine (Radwin & D'Attilio, 1972). The lateral tooth is of moderate size and unexceptional. The rachidian is moderately broad and five cusped. The broadly rectangular base of the rachidian tooth has square or bluntly lobate lower corners. The central cusp is long and slender and projects far in front of the other cusps on a

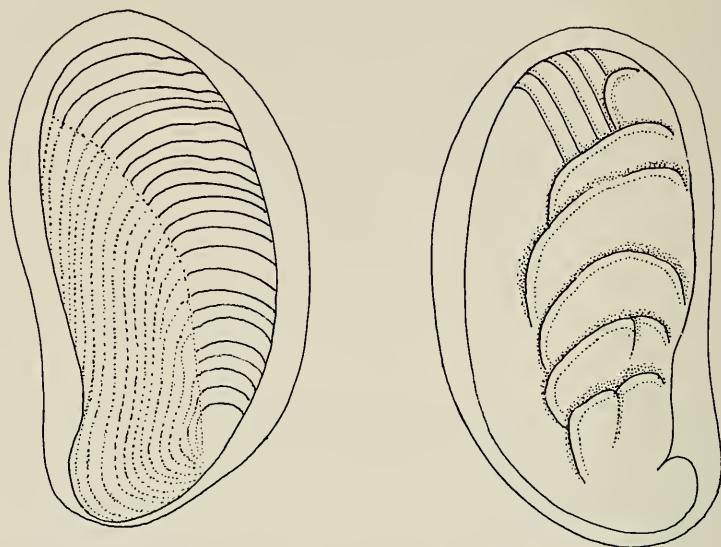


FIG. 14. *E. rufonotata*: operculum—left, exterior; right, interior.

moderately slender cowl. The lateral cusps are heavy and moderately long (about two-thirds the length of the central). The very small, independent, intermediate cusps are situated between the central and each lateral.

The operculum is muricoid and resembles the muricine type more than it does any other. It is thin and corneous and roughly kidney shaped. The outer surface shows growth lines, becoming ephemeral in its lower and left-hand areas. The inner surface shows a few parietal growth lines and numerous, low, flat-topped ridges.

Evokesia ferruginosa (Reeve, 1856) NEW COMBINATION

Figure 1A

Ricinula ferruginosa Reeve, 1856, vol. 3, *Ricinula*, pl. 6, fig. 50.

Morula ferruginosa (Reeve) Keen, 1958, p. 376, sp. 411.

Morula (Morunella) ferruginosa (Reeve) Keen, 1971, p. 554, fig. 1092.

Distribution: Magdalena Bay, Baja California, Mexico, along the entire western shore of the Gulf of California, and on the eastern shore south to Guaymas, Sonora, Mexico.

The shell of this species is moderately small (23–30 mm) and fusiform. The spire is high and acute, consisting of three and one-half rapidly expanding, papillose nuclear whorls and six weakly angulate, postnuclear whorls. The sutures are weakly impressed to completely obscure. The

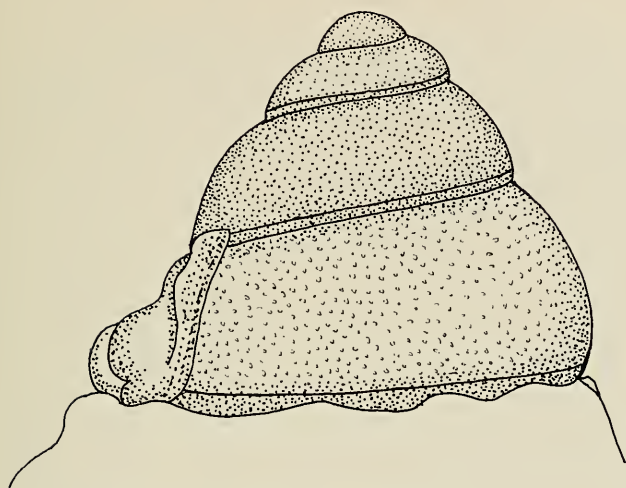


FIG. 15. *Evokesia ferruginosa*: protoconch.

body whorl is moderately large and sub-ovate, with a narrow, moderately deep anal sulcus, angled toward the columella. A very weak transverse ridge forms the left side of the anal sulcus. The outer apertural lip is unthickened to weakly thickened and minutely, marginally crenulate. The inner surface of the outer lip bears a series of four more or less weakly developed denticles recessed a short distance into the aperture. The inner lip is entirely adherent and smooth. The siphonal canal is short, open, bent to the left and dorsally recurved.

The shell is essentially non-variccate. Axial sculpture consists of seven to nine low costae, most prominent over the major spiral cords. Spiral sculpture consists of five major cords and numerous minor cords arranged as follows: immediately below the suture a single major cord is evident, the major cord at the shoulder margin is the most prominent one; three other major cords are distributed evenly over the lower half of the body; a single major cord is found at the top of the short siphonal canal; six minor cords separate the shoulder margin cord from the major cord below it. In all other cases, four minor cords occupy the space between each two neighboring major cords. Sharp, transversely elongate knobs are developed where the major cords intersect the costae.

Shell color is uniformly dark brown-black, except for white areas on the major cords immediately after the knobs. These white areas are erratically present on all cords except for the shoulder margin cord, where they are consistent. The aperture is blue-gray except for a dark brown margin and white denticles.

The shell is typically encrusted with coralline algae and mature speci-

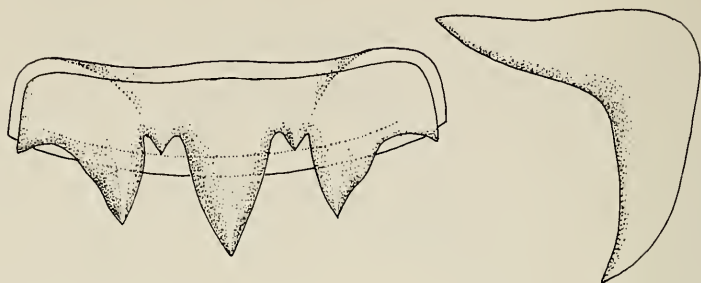


FIG. 16. *E. ferruginosa*: two-thirds of a transverse row of radular teeth.

mens frequently have a soft brown surface deposit on the spire. The nature of this deposit has not been determined.

The radular dentition of this species is muricopsine (Radwin & D'Attilio, 1972). In many ways it closely resembles that of *E. rufonotata*. It differs from it only in the greater proportional size of the lateral teeth and the greater breadth and bulging of the lateral cusps. The lateral tooth is large and simple. The rachidian is moderately broad and five cusped. The base of the rachidian is moderately broad and almost rectangular, with little or no projection of the lower corners. The central cusp is moderately long, somewhat broader than that of *E. rufonotata*, and projecting far ahead of the other cusps on a moderately slender cowl. The lateral cusps are moderately long and quite broad, with a distinctive bulge on the outer surface of each, visible in some views. The intermediates are tiny and are situated between the central cusp and each lateral cusp.

The operculum resembles the muricine type. It is moderately thin and corneous. The margin is exceptionally thin and fragile. On the inner surface, there is a moderately thickened ridge that follows the contours of the margin. The eccentric depressed region contains three or four low, roughly concentric, flat-topped ridges. The outer surface shows several parietal growth lines, the raised margins of a number of which have a frayed appearance.

Certain disparities in the details of the protoconch and small differences in the radular dentition and operculum have caused us to assign this species only tentatively to *Evokesia*.

A third group of obscure, small moruloid muricids, apparently limited to the Panamic faunal province, has also been studied. A treatment of this group follows. Although only one of three species included here has been previously described, specimens of all three species may turn up in collections from the Gulf of California and West Mexico.

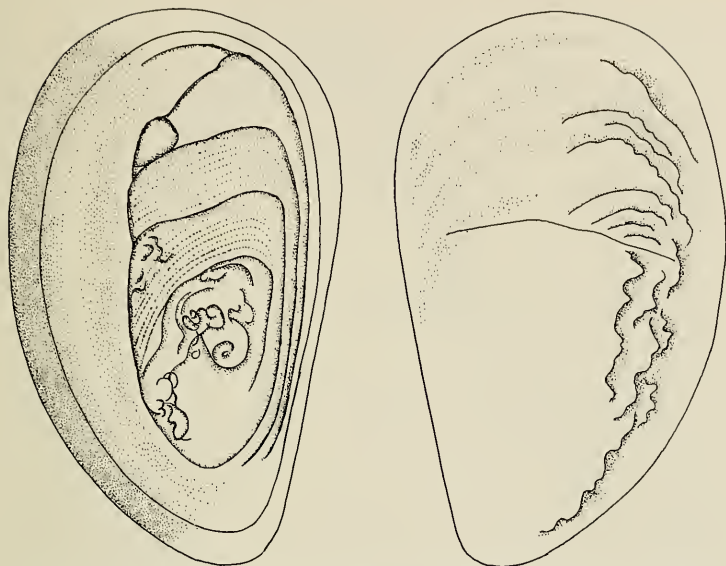


FIG. 17. *E. ferruginosa*: operculum—left, interior; right, exterior.

Bizetiella Radwin & D'Attilio, new genus

Type-species: *Tritonalia carmen* Lowe, 1935.

Diagnosis: Shell small (9–15 mm), moderately thin to thick, broadly fusiform; spire moderately high to high and acute; aperture moderately large and ovate, outer apertural lip weakly marginally thickened and lirate to weakly denticulate within; inner lip entirely adherent and smooth; sculpture of two to four strong cords on the body, knobby over varices; radular dentition muricopsine (Radwin & D'Attilio, 1972). Lateral tooth simple and small, rachidian small and compact, with the lower corners of the base of the rachidian produced into prominent, cusplike points; a small, strongly projecting central cusp is borne on a broad cowl; the large, heavy lateral cusps are unusually close to the midline of the tooth; and tiny intermediate cusps are closely associated with the lateral cusps; operculum of the muricine type but not definitive, its outer surface faintly annulate, inner surface almost featureless; protoconch unexceptional, consisting of two or three convex, glossy whorls.

Etymology: The basis for this generic name stems from the trivial name of its type-species. Thus from *-carmen-* comes *Bizetiella* (little Bizet), the composer of the opera *Carmen*.

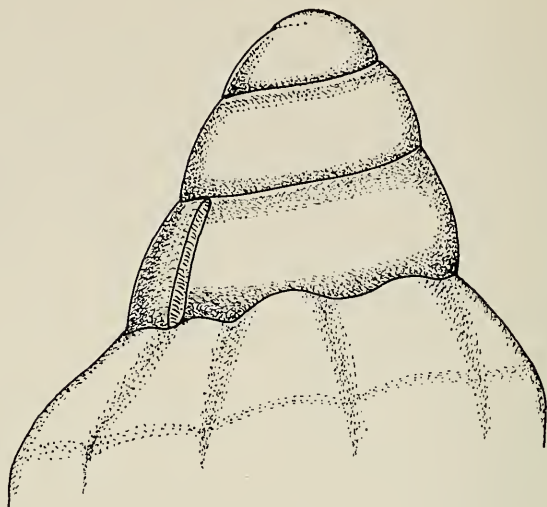


FIG. 18. *Bizetiella carmen*: protoconch.

Bizetiella carmen (Lowe, 1935) NEW COMBINATION
Figure 1F

Tritonalia carmen Lowe, 1935, vol. 8, no. 6, p. 20.

Ocenebra carmen (Lowe) Keen, 1958, p. 359, fig. 353.

Attiliosa carmen (Lowe) Keen, 1971, p. 529, fig. 1020.

Distribution: Central Gulf of California; Angel de La Guarda Island to La Paz and at Guaymas, Mexico.

The shell of *B. carmen* is small (7–10 mm) and fusiform. The spire is high and acute, consisting of three convex nuclear whorls and four or five strongly shouldered, postnuclear whorls. The sutures are impressed. The body whorl is moderately large, fusoid, and strongly constricted below the periphery. The aperture is sub-ovate, with a broad entrance into the moderately broadly open siphonal canal, and no perceptible anal sulcus. The outer apertural lip is non-erect and weakly, broadly crenulate. The inner surface of the outer lip bears eight moderately weak lirations, two in the shoulder region and six below it. The inner lip is entirely adherent and smooth. The siphonal canal is moderately short and open, bent to the left and dorsally recurved.

The body whorl bears five erect, sub-spinose varices. Intervarical axial sculpture is lacking, except for weak growth lamellae. Spiral sculpture consists of major and minor cords. Three strong major cords are evident on the body, diminishing in prominence with anterior progress; one at the shoulder margin, one medially and one basally. A single minor

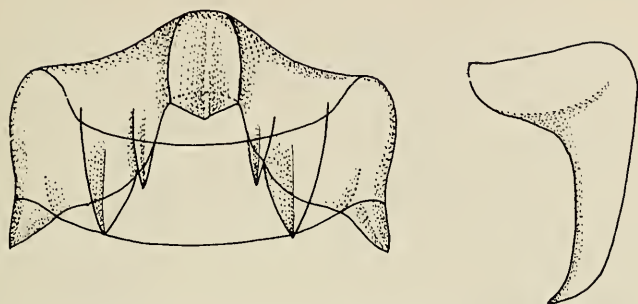


FIG. 19. *B. carmen*: two-thirds of a transverse row of radular teeth.

cord, between the upper two major cords, is visible only on the varix. A series of two or three minor cords are present on the upper canal.

Shell color is white to waxy yellow-orange. In some specimens, intervarical blotches of brown are evident on the shoulder.

The radular dentition is muricopsine (Radwin & D'Attilio, 1972). The lateral tooth is proportionally quite small and simple. The rachidian tooth is small and solid, and its base is almost square. The compactness of the base is also reflected in the tightly bunched cusps appended to it. The central cusp is stout and projects a short distance in advance of the other cusps on a moderately broad cowl. The lower front corners of the base are produced into cusplike points. The lateral cusps are heavy and are almost as long as the central. They are situated as close to the central cusp as to the outer edge of the tooth. The intermediate cusps are very small and closely associated with the inner surface of the lateral cusps, generally appearing, at least partially, coalescent with them.

The tiny operculum of this species is almost featureless. It is roughly semicircular, thin and corneous. The outer surface has numerous ephemeral growth lines. The inner surface has a polished outer margin and a dull, apparently barely depressed central region that shows no details.

Since its description almost 40 years ago this species has led an unclear generic existence. Although its identity and validity as a distinct Panamic species has never been in doubt, its placement first in *Tritonalia* and later in its objective synonym, *Ocenebra*, has seemed irreconcilable with its shell features. A comparison of its shell, radular dentition, and opercular morphology, with those of the type of *Ocenebra* (*O. erinacea* Linne), and of other West American species of that genus has shown the need for an appropriate new generic taxon.

Bizetiella micaela Radwin & D'Attilio, new species

Figures 1 C,H

Distribution: Known only from Coastocomate Cove, Navidad Bay and Tamarindo Cove, Tenacatita Bay, both Jalisco, Mexico.

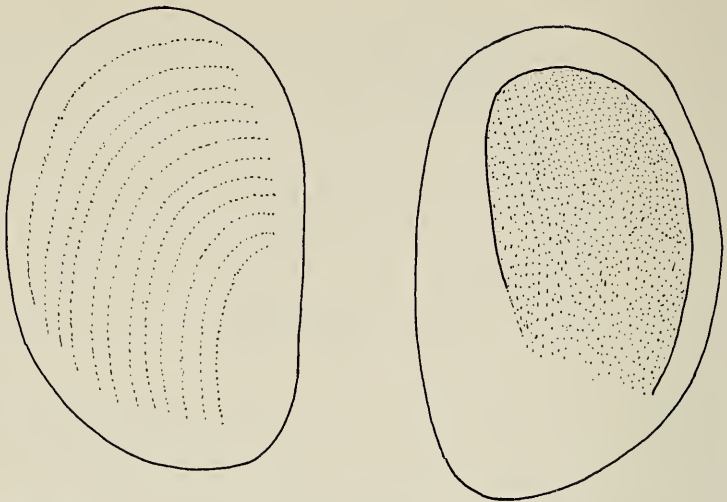


FIG. 20. *B. carmen*: operculum—left, exterior; right, interior.

The shell of this species is small (7–9 mm) and broadly fusiform. The spire is high and acute, consisting of two and one-half convex nuclear whorls and four and one-half strongly angulate, postnuclear whorls. The sutures are strongly impressed. The body whorl is moderately large and broadly fusoid. The aperture is moderately broad and ovate, with a broad, shallow anal sulcus. The posterior end of the outer apertural lip is arcuate, almost reaching the shoulder margin of the previous whorl. The margin of the outer apertural lip is erect, moderately thickened, and broadly, gently undulate. Eight denticles are apparent on the inner surface of the outer lip; two in the shoulder region and six below, the anterior-most being the most prominent. The inner lip is entirely adherent and smooth except for a knoblike protuberance where it makes a sharp angle entering the siphonal canal. The siphonal canal is moderately short and open, bent to the right and dorsally recurved.

The body whorl bears five low to moderately prominent varices. Spiral sculpture consists of two approximately equal-sized major cords on the body, one at the shoulder margin, and one near the base of the body. These cords are intervarically ephemeral, becoming prominent only immediately before and on the varices. Other sculpture is lacking.

Shell color is white with two broad, interrupted, transverse, pale red-brown bands, one just above the shoulder margin and one between the two spiral cords. The interrupted nature of these bands is due to their disappearance immediately after each varix, the markings being apparent just before and on each varix. The aperture is white with a rosy pink suffusion on the columella.

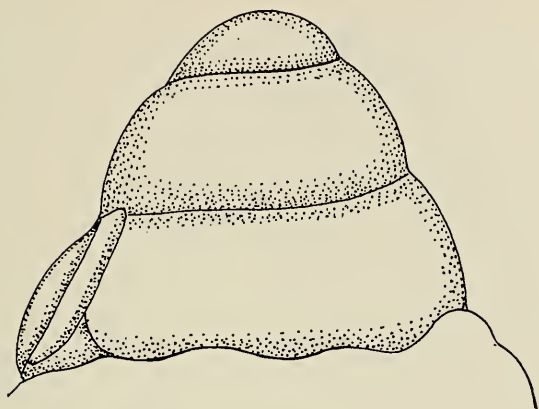


FIG. 21. *Bizetiella micaela*: protoconch.

The radular dentition is muricopsine and very similar to that of *B. carmen*. The major differences between the two are the differently shaped, smaller lateral teeth of *B. micaela*. The lateral tooth is hook-shaped rather than sickle-shaped as in *B. carmen*. In addition, the central cusp of *B. micaela* is borne on a somewhat narrower, lower cowl than that of *B. carmen*. The rachidian tooth of *B. micaela* is somewhat less compact with a rectangular base. The lower corners of the base are pointed but are not as cusplike in shape as in *M. carmen*. The central cusp projects far ahead of the other cusps on a moderately broad cowl. The moderately large lateral cusps and their associated tiny intermediate cusps are not situated as close to the midline as in *B. carmen*.

The operculum shows ephemeral growth lines on the outer surface and the inner surface is almost featureless. An irregular, depressed area,

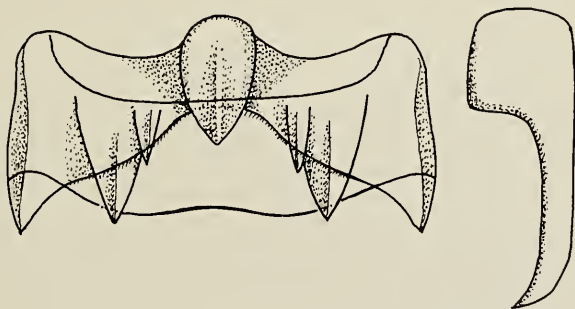


FIG. 22. *B. micaela*: two-thirds of a transverse row of radular teeth.

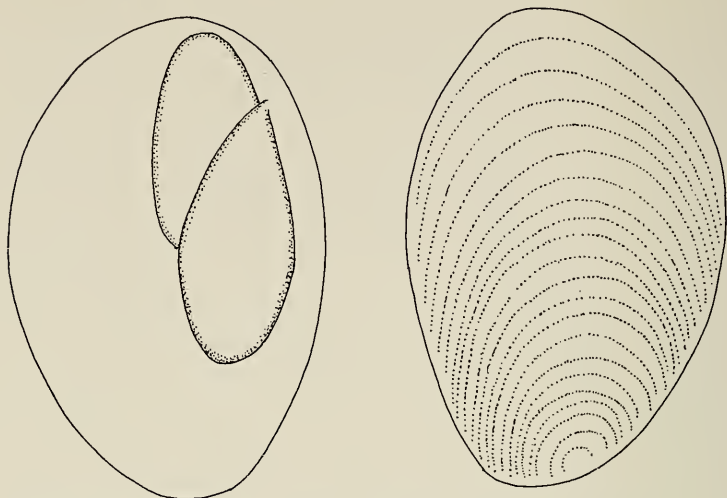


FIG. 23. *B. micaela*: operculum—left, interior; right, exterior.

bisected by a shallow groove, is surrounded by a broader, shiny, smooth, barely raised zone.

Measurements: Holotype—length, 8.7 mm; width, 4.5 mm. Largest paratype—8.4 mm; width, 4.1 mm. Smallest mature paratype—length, 5.4 mm; width, 3.2 mm.

Type-locality: Coastocamate Cove, Navidad Bay, Jalisco, Mexico, 10–30 feet, Donald R. Shasky, 13–20 October 1968.

Type depositories: Holotype, SDSNH 56118; 3 paratypes, SDSNH 51822, 13–20 October 1968, 1 paratype, SDSNH 51823, 17 October 1968, all from the type-locality. 8 paratypes, D. R. Shasky Coll., 8–9 August 1965, Tamarindo Cove, Tenacatita Bay, Jalisco, Mexico, 5–10 feet depth.

This species has generally been confused with *Evokesia rufonotata* or mixed with specimens of that species and its distinctness has thus gone unnoticed. This is primarily because the two species are generally about the same size and live together on the undersides of small to moderately large rocks in shallow water. Also responsible for the anonymity of the present species is the fact that it and *Evokesia rufonotata* are inevitably encrusted with calcareous algae. The two species can be separated on the basis of the following differences in shell morphology. The well-formed, ovate aperture of *E. rufonotata* is bounded by a weak, sloping shoulder; its spire is higher and its aperture is white marginally; gold-colored within. *B. micaela* is generally somewhat smaller, has a strongly shouldered whorl causing the posterior margin of the aperture to be flattened, a somewhat lower spire, and a white aperture with a rosy pink columellar suffusion.

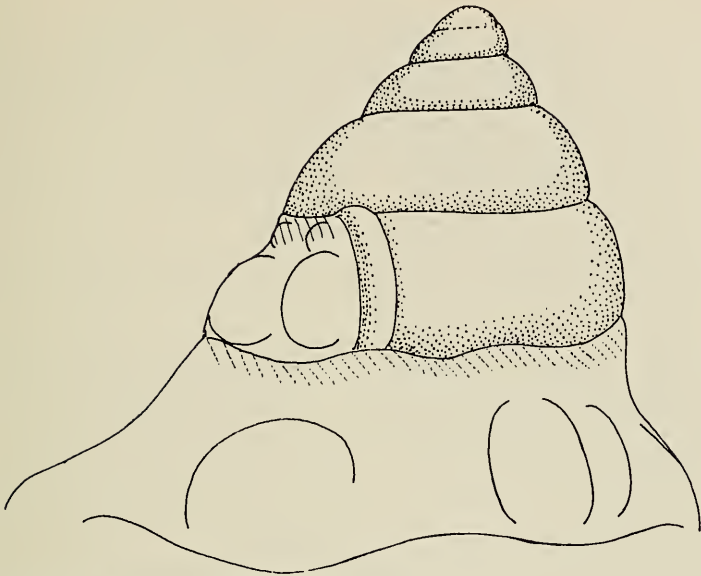


FIG. 24. *Bizetiella shaskyi*: protoconch.

The basis for the present name is the secondary female lead character in the opera "Carmen," in keeping with the name of the genus and the trivial name of the type-species (*Bizetiella carmen*).

***Bizetiella shaskyi* Radwin & D'Attilio, new species**

Figures 1 D,E

Distribution: The Tres Marias Islands, Cabo Pulmo, Baja California, and Banderas Bay, Jalisco, all Mexico; Perlas Islands, Panama and from the Galapagos Islands, Ecuador.

The shell of *B. shaskyi* is moderately small (9–13.5 mm) and rhomboid in outline. The spire is high, consisting of three and one-half weakly convex nuclear whorls and five shouldered, postnuclear whorls. The shoulder region of each whorl is weakly concave. The sutures are impressed and strongly undulate. The body whorl is moderately large and broadly fusoid. The aperture is widely ovate with a broad, shallow anal sulcus. The outer apertural lip is weakly thickened and non-erect. The inner surface of the outer apertural lip bears five lirae and a knobby swelling at its anterior end. The inner lip is adherent, with a weak transverse ridge delimiting the left side of the anal sulcus, and with another ridge at its anterior end. The siphonal canal is moderately broadly open and short, is weakly bent to the left, and dorsally recurved.

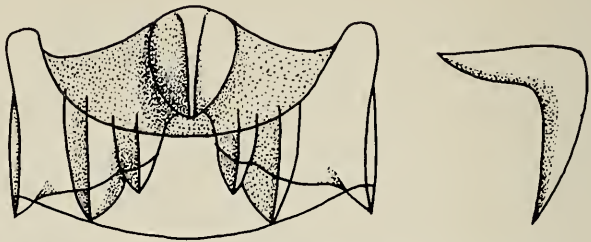


FIG. 25. *B. shaskyi*: two-thirds of a transverse row of radular teeth.

The body whorl bears eight weakly defined varices. Intervarical axial sculpture is lacking. Spiral sculpture consists of major and minor cords. The shoulder region lacks sculpture. Progressing anteriorly from the shoulder margin one notes a pair of major cords, a single minor cord, another major cord, followed by another minor cord, and a final major cord. Where the major cords intersect the varices, sharp transversely elongate nodes are developed, most strongly on the uppermost pair of cords. The siphonal canal has no spiral sculpture.

Shell color is pale blue-white with spiral bands of ivory subsuturally and on the canal. Numerous brown markings are apparent between the spiral cords, just before and on each varix.

The radular dentition is muricopsine and very similar to that of *B. carmen* and *B. micaela*. The primary radular differences between this species and the other two are that the lateral teeth in *B. shaskyi* are the smallest of the three and the intermediate cusps of the rachidian are the largest. The base of the rachidian tooth is almost square and thus, is very compact looking. The lower corners of the base are produced into cusplike points but these are smaller than those of its two congeners. The central cusp is the broadest of the three species and projects ahead of the other cusps on a broad cowl. The lateral cusps are comparatively large and broad. The intermediate cusps are moderately large (about two-thirds the length of the lateral cusps) and broader than their counterparts in the other two species.

Measurements: Holotype—length, 13.5 mm; width, 7.7 mm. Largest paratype—length, 14.0 mm; width, 8.4 mm. Smallest mature paratype—length, 8.3 mm; width, 4.5 mm.

Type-locality: One mile south of Puerto Ballea, Maria Madre Island, Tres Marias Islands, Nayarit, Mexico, 10–15 feet depth, Donald R. Shasky, 22 December 1964.

Type-depositories: Holotype, SDSNH 56119; 5 paratypes, D. R. Shasky Coll., 22 December 1964, all from type-locality. 5 paratypes, SDSNH 34688, February, 1930, Maria Madre Island, Tres Marias Islands, Nayarit, Mexico; 11 paratypes, LACM 65-11, 15 March 1965, South Anchorage, Maria Magdalena Island, Tres Marias Islands, Nayarit,

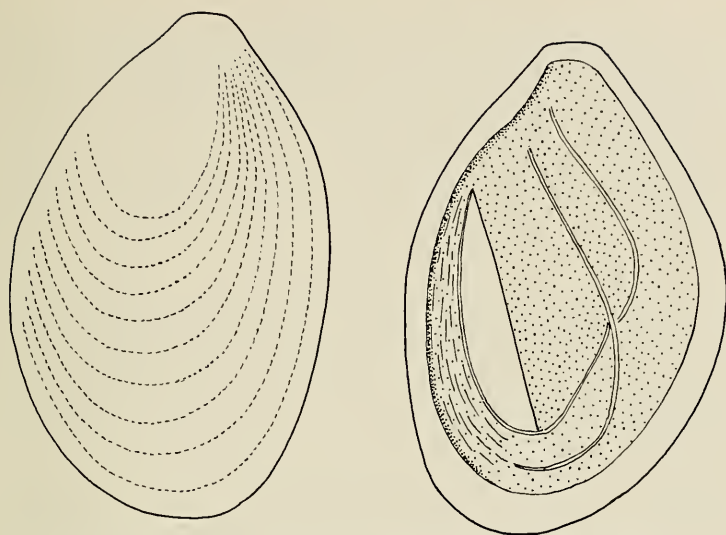


FIG. 26. *B. shaskyi*: operculum—left, interior; right, exterior.

Mexico; 8 paratypes, LACM 65-12, 16-19 March 1965, East Anchorage, Maria Cleopha Island, Tres Marias Islands, Nayarit, Mexico; 23 paratypes, LACM 65-13, 16-18 March 1965, East Anchorage, Maria Cleopha Island, Nayarit, Mexico; 2 paratypes, LACM 65-15, 22 March 1965, Los Arcos, Banderas Bay, Jalisco, Mexico, 15-80 feet depth; 2 paratypes, D. R. Shasky Coll., 27-29 November 1967, Cabo Pulmo, Baja California, Mexico, 25 feet depth; 1 paratype, D. R. Shasky Coll., Perlas Islands, Panama, March, 1971; 3 paratypes, Ameripagos Expedition Collections, Station 14, 19 March 1971, Punta Estrada, southeast side of Academy Bay, Santa Cruz Island, Galapagos Islands, Ecuador, 25-35 feet depth; 2 paratypes, Ameripagos Expedition Collections, Station 21, 21 March 1971, North Seymour Island, Galapagos Islands, Ecuador, 35-45 feet depth; 1 paratype, Ameripagos Expedition Collections, Station 23, 22-24 March 1971, Sombrero Chino Island, Galapagos Islands, Ecuador, 3-8 feet depth; 7 paratypes, Ameripagos Expedition Collections, Station 27, 24 March 1971, Jervis Island, Galapagos Islands, Ecuador, 10-75 feet depth; 1 paratype, Ameripagos Expedition Collections, Station 29, 25 March 1971, Punta Alfaro, Isabela Island, Galapagos Islands, Ecuador, 10-20 feet depth; 2 paratypes, Ameripagos Expedition Collections, Station 21, 26 March 1971, Duncan Island, Galapagos Islands, Ecuador, 3-10 feet depth.

The Ameripagos Expedition was a privately financed expedition to the Galapagos Islands consisting of seven members, most of whom are affiliated with museums.

In collections where specimens of this species have been found, they have been assigned to genera such as *Engina* and *Coralliophila*. Additionally, early inclinations of the authors would have placed the species in *Attiliosa*. All this must emphasize the pitfalls inherent in conclusions based on the study of too few characters.

This species is named for Dr. Donald R. Shasky, who first brought it to our attention and whose collecting zeal and generosity have enriched the collections of many museums.

ACKNOWLEDGMENTS

We gratefully acknowledge our debt to the following friends and colleagues for courtesies and assistance of various kinds in the preparation of this paper: Drs. William K. Emerson, James M. McLean, Joseph Rosewater, Wendell P. Woodring and Donald R. Shasky, Mr. Walter J. Byas, Mrs. Grace M. Boyne, Mrs. Carol A. Allbaugh, Dr. William A. Burns and Mr. David K. Mulliner.

LITERATURE CITED

- ADAMS, C. B. 1845. *Specierum Novarum Conchyliorum in Jamaica Repertorium, Synopsis*. Boston Soc. Nat. Hist. 2:1-17.
- . 1852. *Catalogue of Shells Collected at Panama, with notes on Synonymy, Station and Habitat*. Ann. Lyc. Nat. Hist. New York 5:222-549.
- ARAKAWA, K. Y. 1962. A study of the Radulae of the Japanese Muricidae (1)—The Genera *Purpura*, *Thais* and *Mancinella*. Venus, Japanese Jour. Malac. 22(1):70-78, pls. 5, 6.
- . 1964. A Study on the Radulae of the Japanese Muricidae (2)—The Genera *Vexilla*, *Nassa*, *Rapana*, *Murex*, *Chicoreus* and *Homalocantha*. Venus, Japanese Jour. Malac. 22(4):355-364, pl. 21.
- . 1965. A Study on the Radulae of the Japanese Muricidae (3)—The Genera *Drupa*, *Drupina*, *Drupella*, *Cronia*, *Morula*, *Morulina*, *Phrygiomurex*, *Cymia* and *Tenguella* gen. nov. Venus, Japanese Jour. Malac. 24(2):113-126, pls. 13-14.
- BURCH, T. 1940. Addition to the Molluscan Fauna of California. The Nautilus 54(2):46-47, pl. 2, figs. 5-7.
- . 1942. [no title] Minutes of the Conchological Club of Southern California, no. 17, p. 7.
- CARPENTER, P. O. 1864. Diagnosis of New Forms of Mollusks Collected at Cape San Lucas, Lower California, by Mr. J. Xantus. Ann. Mag. Nat. Hist., Series 3, vol. 14, pp. 45-49.
- DALL, W. H. 1889. Report on the Results of Dredging . . . "Blake." Report on the Mollusca. Bull. Mus. Comp. Zool., Harvard 18: 482 pp., pls. 10-40.
- DUCLOS, P. L. 1832. Description de Quelques Especès de Pourpres,

- Servant de Type a Six Sections Etablies dans ce Genre. Anal. Sci. Nat., Paris, 26:103-112, pls. 1, 2. [Not seen.]
- EMERSON, W. K., AND L. G. HERTLEIN. 1964. Invertebrate Megafossils of the Belvedere Expedition to the Gulf of California. Trans. San Diego Soc. Nat. Hist. 13(17):333-368.
- JOHNSON, C. W. 1934. List of Marine Mollusca of the Atlantic Coast from Labrador to Texas. Proc. Boston Soc. Nat. Hist. 40:204 pp.
- KEEN, A. M. 1958. Sea Shells of Tropical West America; Marine Mollusks from Lower California to Colombia. i-xi + 624 pp., Stanford University Press, Stanford, California.
- . 1968. West American Mollusk Types at the British Museum (Natural History), IV, Carpenter's Mazatlan Collection. The Veliger 10(4):389-439.
- . 1971. Sea Shells of Tropical West America, Ed. 2, pp. i-xiv and 1-1064, pls. 1-22.
- LAMARCK, J. B. P. A. 1816. Tableau Encyclopedique et Methodique des Trois Regnes de la Nature, pls. 391-488.
- . 1822. Histoire Naturelle des Animaux Sans Vertèbres 7:711 pp.
- LOWE, H. N. 1935. New Marine Mollusca from West Mexico, together with a List of Shells Collected at Punta Penasco, Sonora, Mexico. Trans. San Diego Soc. Nat. Hist. 8(6):15-34, pls. 1-4.
- MÖRCH, O. A. L. 1852-53. Catalogus Conchyliorum Que Reliquit D. Alphonso d'Aguirra et Gadea, Comes de Yoldi, Hafniae, fasc. 1, 170 pp.
- OLSSON, A. A. 1922. The Miocene of Northern Costa Rica. Bulls. American Paleont. 9(39):7-309, pls. 1-32.
- PILSBRY, H. A., AND H. N. LOWE. 1932. West Mexican and Central American Mollusks Collected by H. N. Lowe. 1929-31, Proc. Acad. Nat. Sci. Philadelphia 84:33-144.
- RADWIN, G. E., AND A. D'ATTILIO. 1972. A Classification of the Muricaceae with special reference to the radula. The Echo (Ann. Rept. Western Soc. Malac. for 1971), pp. 55-67.
- REEVE, L. A. 1846-56. Conchologia Iconica, vol. 3, *Ricinula*, Reeve, London, pls. 1-54.
- RÖDING, J. F. 1798. Museum Boltenianum . . . , Trapp, Hamburg, pt. 2, 199 pp.
- SCHUMACHER, H. C. F. 1817. Essai d'un Nouveau Systeme des Habitations des Vers Testaces . . . , Schultze, Copenhagen, 287 pp.
- SCHWENDEL, J. S. 1943. New Marine Shells from Florida. Nautilus 56(2):62-66, pl. 3.
- TRYON, G. W. 1880. Manual of Conchology, vol. 2, Tryon, Philadelphia, 289 pp., pls. 1-70.
- WARMKE, G., AND R. T. ABBOTT. 1961. Caribbean Seashells. Livingston Co., Narberth, Pa., 346 pp., pls. 1-44.
- WEISBORD, N. E. 1962. Late Cenozoic Gastropods from Northern

- Venezuela. *Bulls. American Paleont.* 42(193):672 pp., pls. 1-48.
- WOODRING, W. P. 1928. Miocene Mollusks from Bowden, Jamaica. *Contributions to the Geology and Paleontology of the West Indies*. Carnegie Institute of Washington, pt. 2 (Gastropoda), Publication #385, 564 pp., pls. 1-40.
- WU, SHI KUEI. 1965. Studies of the Radulae of Taiwan Muricid Gastropods. *Bull. Inst. Zool., Acad. Sinica* 4:95-106.
- . 1968. On Some Radulae of the Muricid Gastropods. *Venus, Japanese Jour. Malac.* 27(3):89-94, pl. 4.